DOCUMENT RESUME

ED 357 266 CE 063 694

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TITLE Some Psychological Aspects of Distance Education.
INSTITUTION Fern Univ., Hagen (Germany). Inst. for Research into Distance Education.
PUB DATE May 93
NOTE 40p.
PUB TYPE Information Analyses (070)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Adult Education; *Distance Education; Educational Media; Educational Psychology; Educational Technology; Foreign Countries; Higher Education; Learning Modalities; Learning Processes; *Learning Strategies; Learning Theories; Lifelong Learning; Postsecondary Education; Psychoeducational Methods; Psychological Studies; Readability Formulas; Student Characteristics; Teaching Methods; Telecommunications; *Textbook Preparation

ABSTRACT

The constituting elements of distance education are the course and the interaction between students and supporting organizations. Compared with students at traditional universities, distance students are generally older, have jobs, and often have families. In distance education, learners are usually isolated and want to broaden their education, not receive a degree. Many distance education courses are characterized by a high level of structuring; they provide few incentives for the development of an active-constructive conception and rather lead to a passive-reproductive conception. Distance learning demands a high degree of self-discipline, organization, and planning. Studies have demonstrated that all teaching and learning theories can be easily applied to distance education. The most important medium is still written material. Theories of text comprehension include additive-elementary, holistic, and integrative approaches. No instructional theory makes it possible to coordinate the implications of these theoretical approaches into instructional rules manageable for practical use. Aids to a learner-friendly text design are readability formulas and concepts for the assessment of the text comprehensibly and general evaluation procedures. Learning aids can include advance organizers, learning objectives, and questions in the text. The possibilities of telecommunication to decrease the turnaround time are important because long turnaround times hinder motivation and increase the dropout rate. (Contains 229 references.) (YLB)

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Some Psychological Aspects of Distance Education

Rudolf Schuemer

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Hagen, Mai 1993

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Some psychological aspects of distance education

Rudolf Schuemer, ZIFF

1 The concept of distance education and applications of distance education[1)]

The term distance education "covers the various forms of study at all levels which are not under the continuous, immediate supervision of tutors present with their students in lecture rooms or on the same premises but which, nevertheless, benefit from the planning, guidance and teaching of a supporting organisation" (Holmberg 1989, p. 3).

Distance education is based on mediated communication between learners and teachers of the distance-education organisation (university, school). Therefore, learning in distance education is always a "learning with media" (cf. section 5). The task of the teachers or tutors in distance education is to support learners by teaching, counselling and administrative measures. In the German tradition of distance education, the distance-education institutions are, according to Delling, often referred to as "*supporting organisations*".

The constituting elements of normal distance education are 1) the pre-produced distance-education course and 2) the interaction - by mail, telephone or other means - between the students and the supporting organisation. This interaction in most cases mainly consists of students solving assignment problems and tutors correcting and commenting on students' work. While the latter element represents real communication, the distance-education course often simulates a personal communication as the result of course developers' efforts to make the courses as self-instructional as possible. Consequently, distance education is often referred to as *correspondence* study.

The functions or forms of the pre-produced courses as well as of the real communication differ according to the learning and teaching objectives, the type of subject matter and the level of learning.

Among the media used in distance education, the printed and written word is dominant. Nearly all distance-education courses consist of printed components, which, however, are in many cases supported by radio or television programmes, audio or or video recordings. In some cases, there may be optional or obligatory face-to-face sessions supplementing distance education.

In real communication, written correspondence is the most important medium; contacts by telephone are also quite frequent. Furthermore, telephone, video and computer conferences are being used - e.g. to bring about seminars. Computer conferences may also be used by distance students for communication

1) Section 1 of this paper gives a short outline of the concept of distance education, on which the discussion in the following sections is based.

among themselves or with course tutors. So-called electronic mail or fax are increasingly being used for assignments in order to reduce turn-around times.

Applications of distance education: Organised distance education has been known since the second part of the 19th century. A number of comparative studies have proved the effectiveness of this form of learning (Childs 1971, Granholm 1971). Ample experience has been gathered, above all, in school subjects and occupational training, including preparations for school certificates and examinations, engineering and business administration (Gaddén 1973). Distance-eduaction courses for staff development and on-the-job training are also of interest (Schwalbe & Zander 1984).

In higher education distance education has also been used to a great extent, either as an additional offer beside the traditional forms of teaching and learning or as its main mode of operation. The former is common in Australia, Canada and the United States. There are independent distance-education institutions representing the latter in almost every part of the world. At the beginning of the 90s, there are at least 30 independent distance-education institutions at the university level, the biggest and best-known of them being the Open University in Great Britain. There are also distance-education universities in Germany, the Netherlands, Spain, Israel, South Africa, Thailand, Venezuela and in a number of developing countries.

2 Distance-education students and their situation

Distance-education students are, in comparison to students at traditional universities, generally older (mostly 30 years and older), they have jobs and often families (cf. i.a. Miller 1991); additionally, many female distance students, in accordance with the traditional role understanding, have to run the household and look after the children.

A 'typical' student at a conventional university begins his or her studies immediately after having finished school (and, if necessary, after having completed the military or alternative service). The student is free from any other obligation so that he or she is able to gain experience without having to take the responsibility or the consequences (the so-called 'moratorium' - cf. Miller 1991, p. 49). Contrary to this many distance students are confronted with the necessity to coordinate different areas of life which influence each other - such as family, job, spare time and (distance) studies - and to meet the sometimes conflicting requirements and commitments resulting from this situation (Miller 1991 and Miller & Lück 1987; cf. also Cropley and Kahl 1983 and Holmberg 1989, p. 34).

Due to the multitude of commitments of these kinds, lack of time turns out to be a serious obstacle for many distance students to reaching their study goals; additionally, what may make matters worse is the fact that many students feel guilty thinking they can only realize their wish to study at the expense of their

partner and children (cf. Miller 1991). The relatively high drop-out rate in distance education may be, at least partly, a result of this special situation (compared to the situation of students at corresponding conventional institutions). (Concerning the drop-out in distance education cf. e.g. Bååth 1984, Bajtelsmit 1988, Peters 1988 or Schuemer & Ströhlein 1991; cf. also Fritsch 1991 who describes different forms of drop out.)

Cropley & Kahl (1983) refer to some further psychological differences between distance and conventional education. In distance education the learner is usually isolated; if we do not take into account face-to-face sessions or attendance at regional study centres, distance education not only lacks motivational factors arising from the contact or the competition with others in face-to-face classes; it also lacks the immediate support of a teacher who is present and able to motivate and, if necessary, give his/her attention to actual needs and the difficulties and problems of individual learners that crop up during the study (even if the lack of immediate support can, at least partly, be compensated by mediated interaction with a tutor). This means that distance students have to take over personal responsibility for their own learning process ("learner independence" or "learner autonomy": cf. below).

Furthermore, we have to take into account that the reasons for beginning distance-study courses may vary. There are students who have started their distance studies with the aim of reaching a final degree (e.g. a diploma) and/or of qualifying for a better position. A larger group of students take up distance study to broaden their education; for these a degree or qualification for a better job is of only secondary importance (e.g. older students who want to carry out a study wish they have cherished for a long time but not realized). The psychological situation of these and other groups of distance students may vary considerably.

3 Types of learning and the influence of various teaching methods

It is typical of many recent cognitive theoretical approaches that learning or acquisition of knowledge is not understood as a passive process in which the learner merely receives information or knowledge as a finished product. Instead it is seen as an active, constructive process, in which the learner interprets information and tries to connect it with already existing knowledge and to fit it into existing cognitive structures - cf. e.g Shuell (1988) who describes learning as an active, constructive, cumulative and goal-orientated process; cf. also Resnik (1989b, pp. 2ff), who points out that constructivism is (apart from the importance of previous knowledge and the situational context of learning) one of the main results of recent cognitive research important for instructional psychology.

However, many distance-education courses are characterized by a high level of structuring and by the fact that the knowledge to be learned is presented as a ready-made system; for such a teaching method Weingartz (1981) coined the term '*system-orientated*' teaching method, which she contrasted with the term '*problem-*

orientated' teaching method - following a conception of learning as 'insight by error' developed by Lehner (1979) (cf. Bruner's 'discovery learning'). System-orientated distance-study courses run the risk of degenerating into 'spoon-feeding' knowledge in the sense of given truths; cf. also Shaw & Taylor (1984) who talk of "too much teaching and not enough learning" (p. 283) and hint at the danger that highly structured learning packages do not create autonomous learners but lead, on the contrary, to a dependence on the teaching system.

On the part of the learner, the teaching method probably influences the depth of processing and the extent of elaboration respectively: It seems plausible that a system-orientated method of presentation leads learners - especially when they have to work under great time-pressure - to a kind of surface learning, aiming at reproduction, rather than to a 'deeper' learning, aiming at understanding.

The question which learning method and strategy the learner chooses probably depends not only on the way of presentation, but also on the kind of questions and tasks given to check the assimilation of a text: Marton & Säljö (1976a,b) report that the kind of questions used in a text and the expectations arising from this as regards later exams affect the way of learning in the sense of *surface* or *deep learning*. In the case of surface learning, priority is not given to the 'real' contents but to the external characteristics of a text, and not to principles but to examples (cf. also Marton 1983, Marton et al 1984, Entwistle 1987, Ferguson-Hessler & de Jong 1990 and Shu-Lun Wong 1992; cf. further the related concepts of the depth of processing and of understanding or of the level of elaboration - concerning this cf. i.a. Watkins 1983 or Ballstaedt & Mandl 1984, who also establish relations to the 'level of processing' approach; cf. also Weidenmann 1986, pp. 513ff; cf. further below the section "Learning strategies").

The way learning content is presented probably affects both the *subjective conception* of learning developed by the learners and their ability to learn independently. Simons (1992, pp. 256-7, referring to Vermunt 1987) describes three main categories of subjective conceptions of learning: a) a reproductive conception, b) a conception emphasizing the applicability of acquired information and c) a constructive conception.[2)] The reproductive conception is mostly accompanied by a view of the learner as passive (cf. van Rossum, Deijkers & Hamer 1985). Learners who have developed a more constructive learning conception show better performance not only in tasks requiring constructive cognitive processes but also in reproductive tasks (cf. Vermunt & van Rijswijk 1988).

However, it may be assumed that distance-education courses that have a high level of structure and control and offer the learner few opportunities to choose and

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2) A factor analysis of the Inventory of Learning Styles (ILS) by Vermunt & van Rijswik (1988) yielded four factors: externally regulated and reproduction directed learning style (F1); selfregulated and meaning directed learning style (F2; with high loadings for the scales selfregulation and construction-of-knowledge conception); application directed learning style (F3); and out-of-regulation or problematic learning style (F4).

make decisions, provide few incentives for the development of an active-constructive conception on the part of the learner and rather lead to a passive-reproductive conception. According to Simons (1992) strong teacher control and a passive-reproductive subjective learning conception on the part of the learners are to be regarded as serious obstacles to independent learning.

Simons (1992, p. 251) defines the capability to learn independently as "the degree to which a person is able to direct and control his own learning process without external help" (translation by *r.s.*), and elsewhere (p. 254) he states: "To the same extent to which one is able to be one's own teacher one is also able to learn autonomously" (translation by *r.s.*). According to Simons elements of self-direction are mixed with elements of outside control in all varieties of learning. Consequently each learning process is to a certain extent at the same time autonomous and dependent. If learning is controlled more from the outside, the focus of influencing the teaching-learning process tends to be on the external person or institution, and in the case of self-directed learning the focus is rather on the learner himself. Correspondingly, Simons is of the opinion that a strict division both between learning and autonomous learning and between general learning ability and the capability of self-directed learning makes little sense.

With reference to Gagné (1977), Klauer (1985) and others, Simons (1992, pp. 254f) mentions five functions making learning possible which can be fulfilled both by the teacher and by the learner himself (cf. Shuell 1988): (1) preparing the learning, (2) initiating and carrying out the learning activities, (3) monitoring and regulating learning activities, (4) assessing performance and providing feedback, and (5) activating and maintaining motivation and concentration. For the attainment of the learning objectives it is not important *who* carries out these activities but *that* they are carried out. In Simons' view (pp. 254ff) there are many reasons why these activities should be made the responsibility of the learners; for (p. 256): "If many or all of these activities are always carried out only by a teacher, in the long term the individual's autonomy, and therefore also his ability to learn independently, are hindered" (*translation by r.s.*). Thus, one can speak of autonomous learning when all these activities are carried out by the learner himself.

Simons identifies 14 principles designed to overcome obstacles in the way of active-constructive learning and to encourage autonomous learning - among these principles there are the *principle of usefulness* (to make the learner understand the value of employing learning strategies), the *principle of self-diagnosis* (explicit instruction in the supervision, diagnosis and correction of one's own learning) and the *principle of scaffolding* (gradual reduction of support and transfer of the responsibility for learning and learning control to the learner). The frame model for promoting autonomous learning skills developed by Simons is also - with slight modifications - applicable to distance education.

In the field of distance education independent learning is referred to in at least two different contexts: on the one hand learner autonomy is considered to be the

prerequisite for successful distance learning, on the other hand autonomy is a *goal* or ideal which distance education is meant to serve. With regard to the aspect of independence as a prerequisite it is usually pointed out that a high degree of self-discipline and independence is indispensable for successful distance learning, because distance students mostly have only themselves to rely on. Cropley & Kahl (1983), for instance, point out (p. 32) "that distance learners are thrown back upon their own motivational resources to a greater extent than is the case with face-to-face learners, since many of the factors which provide external motivation are absent or present only in an indirect form in distance education. Internal motivation is a highly desirable thing in face-to-face education, but is a necessary precondition in distance education." Distance students have to take over the responsibility for their learning themselves; they decide on when to begin their studies and on when to learn; they have to carry out their learning activities on their own, and they have to work through the material without supervision, solve tasks and resist distractions from other areas of life; furthermore they have to encourage themselves and - to a certain degree - they also have to evaluate themselves. These requirements as well as the skills and the readiness necessary to meet them are important aspects of what in the literature is referred to as 'self-directed learning'. Thus distance education as a form of learning demands a high degree of self-discipline, self-organization and self-planning. A high degree of 'independence' in this sense is also expected by distance-education institutions, whose programmes are characterized by a high degree of control and few decision opportunities for the students.

Lehner (1991) points out (p. 163) that though it is true that the ideal of self-directed learning in distance education seems to be generally accepted, what is understood by autonomy may differ very much (cf. also Candy 1991 who differentiates between four kinds of self-direction in learning: personal autonomy / self-management in learning / independence in carrying out learning and in pursuing the learning objectives / learner control of the instruction. - On autonomous or independent learning under distance-education conditions see also Moore 1977, 1983, 1986; cf. further the *'control'* concept developed in Baynton 1992 and Garrison & Baynton 1987, which includes, apart from independence, at least competence and support as further components). For Lehner (1991) autonomous learning means (pp. 168f) that the student sets himself/herself tasks for which there are no pre-prepared answers. Thus, he searches for solutions of problems which appear relevant to him. According to Lehner, the extent of the students' independence depends on the degree to which they participate in the planning and implementation of the studies as well as in the assessment of the results of the studies.

Lehner (pp. 163f) differentiates between two types of distance-education institutions - independence-expecting or traditional institutions and autonomy-promoting distance-education institutions -, in which the learner's independence or autonomy means two different things.

In *traditional or independence-expecting distance-education institutions* the emphasis is put on the contents which have to be learned and, consequently, on pre-produced courses and standardized well-prepared learning material. Institutions of this type thus offer programmes consisting of pre-produced courses. The students are expected to fulfill the requirements corresponding to the programme of their choice. In doing so they are supported by the institution to a greater or lesser degree. As in traditional distance education the course material is - for economic reasons - developed and produced for a great number of learners, it is difficult to adapt the material to the individual learner's needs, to his or her prior knowledge, abilities and skills or to his or her individual learning style. Therefore it is difficult to take into account possible *attribute-treatment* or *aptitude-treatment interactions* (ATI; see Cronbach & Snow 1977; cf. also Snow & Swanson 1992).

In *autonomy-promoting institutions* catering for *individualized* forms of distance education, however, the starting point is not the knowledge that has to be imparted and correspondingly pre-produced courses, but the special interests and abilities of the individual. In order to make the studies meaningful for each individual student, the study programme should be entirely or partially drawn up by the students themselves with the support of the institution. A particular form of study which facilitates an individualized learning process is the *contract learning*: Especially in the USA, it represents a common form of independent learning which has been introduced with the expressive aim to counteract conformism and reglementation. The learning contract concluded between a student and the teaching institution includes at least the following aspects: the objectives which should be achieved by the student; the ways and methods necessary to achieve these goals; a precise time plan; and the procedures and methods of evaluating the learning process (cf. Weingartz 1991). (Approaches which also go in the direction of an individualized distance education - even if they do not go equally far - are those of Potvin 1976 or Ljoså & Sandvold 1983; see also the section "Learning objectives" below.)

According to Lehner (p. 164) the two forms of distance education outlined pursue entirely different aims: "Whereas traditional distance education regards autonomy as the learner's responsibility for the execution of the tasks set by the institution, in independent learning autonomy becomes the main goal of the study." Probably not every learner is ready for individualized distance education in Lehner's sense. In Lehner's view (p. 172) one has to take into account that distance students may have built up expectations during an earlier learning experience which can hinder independent learning. The fact that many students reject independent learning does not mean, according to Lehner, that they would not be suited for it; learning styles are not unalterable but they result from learning conditions which remain the same for a longish period of time (cf. Laurillard 1979).

Metacognitive processes and learning strategies: For some years cognitive and instructional psychology has also directed its interest to metacognitive processes and strategies for thinking and learning (on metacognition cf. Weinert & Kluwe

1984 e.g. and on strategies Mandl & Friedrich 1992 e.g.; cf. further Glaser & Bassok 1989, pp. 641ff).

Weinstein & Mayer (1986) identify (apart from affective and motivational strategies) the following classes of learning strategies (cf. also Friedrich & Mandl 1992, pp. 11ff): rehearsal, elaboration, organizational and monitoring strategies. An example of an elaboration strategy is the question scheme developed by Dieckhoff, Brown & Danserau (1982; cf. Mandl, Friedrich & Hron 1986, p. 161) which aims at stimulating elaborative processes (on training methods for question strategies aiming at a better comprehension cf. also Brown, Palincsar & Armbruster 1984). Training measures for the development and improvement of such strategies as well as strategies facilitating effective reading or learning based on texts (e.g. the SQ3R - method according to Robinson 1961 or the training programme 'murder 1 and 2' by Danserau et al 1979) can also be made useful under distance-education conditions, for instance within the framework of introducing booklets which are designed to prepare studying under distance-education conditions (as, e.g., in an introductory course of the FernUniversität; another course on organisation of one's work also deals with self-regulation in distance education; Pütz 1992).

Such strategies, though, do not have positive effects under all circumstances and/or for all learners; in certain learner groups or learning situations they may be dysfunctional (cf. Snow & Swanson 1992, p. 598 and others). It is true that in their evaluation of a course about effective learning, which was designed to promote the deep learning approach rather than the surface approach, Biggs & Rihn (1984) found the expected increase both of performance and of intrinsic motivation. However, in an analysis by Ramsden, Beswick & Bowden (1986), who wanted to convey study strategies orientated at understanding to study beginners (deep approach instead of surface approach), it turned out that under the ordinary conditions of university learning (coping with large amounts of material for short-term tests and examinations) the students soon gave up these strategies and preferred surface strategies, where the literal reproduction of the learning matter is in the foreground. In a similar way Casteñada et al (1984) found out that hierarchical elaboration strategies in some cases ask too much of students with insufficient previous knowledge, and that they are less effective than simpler strategies of connection, grouping or repetition (strategy *x* learner interaction).

Friedrich & Mandl (1992, p. 13) also mention - referring to McKeachie (1987) - "that metacognitive monitoring processes have not, under all conditions, positive effects on learning and thinking ..., but that they possibly lead to an overburdening of the cognitive apparatus and may therefore disturb the processing of information. For example in those cases, when basic cognitive strategies and processes are not yet sufficiently mastered and additional metacognitive actions lead to a split-up of attention." (translation by *r.s.*)

The usefulness of strategies for more effective reading is also disputed; Weidenmann, e.g., (1986, p. 517, with reference to the criticism of Fischer &

Mandl 1981, pp. 392ff) doubts the effectiveness of reading-strategy programmes (in relation to the amount of time and effort invested).

4 The application of instructional theories to distance education

In general, teaching material in distance education is planned in advance and pre-produced. This should be an ideal situation for the application of instructional theories. Nevertheless, in distance education journals there are only comparatively few articles dealing with questions of instructional theories; and neither are there many instructional models specially conceived for distance education. To the latter belong i.a. Homberg's model of the "guided didactic conversation" (cf. Holmberg 1983; Holmberg et al 1982) and an instructional model presented by Verduin & Clark (1991, pp. 155-165) which contains - in simplified terms - the following components: (1) assessment of entering behaviour (i.a. prior knowledge, motivation, learning styles); (2) specification of instructional objectives; (3) design of the learning unit (content, media and procedures); the learning styles and preferences of the target group should be taken into account as far as possible; (4) presentation of teaching material and tasks (including two-way communication) with emphasis on a supportive learning atmosphere; and (5) assessment of the learners' performance and feedback.

There are also few - especially comparative - investigations dealing with the application of general (i.e. not distance study specific) instructional theories and models under distance-education conditions. An important exception is Bååth's monograph of 1979 (cf. further Bååth 1982, 1983), in which the author examined the applicability of various teaching and learning theories (of the 60s and 70s) to distance education. Bååth analyzed the implications of these models with regard to the development and design of the course material, the mediated two-way communication (e.g. the learner-tutor communication by letter or by telephone) and supplementary face-to-face contacts between learner and tutor; furthermore he examined the possible function of computer-assisted instruction in the framework of the various models.

Bååth deals with seven models (in brackets there is a brief characterization of each model according to Bååth):

(1) the *behaviour control model* of Skinner (1957, 1968, 1969, 1971) (extremely behaviouristic with strict control of the learning process through instruction).

(2) the *model for written instruction* of Rothkopf (1970, 1976) (moderately behaviouristic with rather strict control). Rothkopf advocates brief study instructions for existing textbooks. Study instructions mainly have the function to promote and direct the 'mathemagenic activities' of the learner - e.g. by means of questions inserted into the text.

(3) the *advance organizer model* of Ausubel (1963, 1967, 1968 i.a.) (moderately cognitivistic with rather strict control; orientated at the learning of meaningful verbal material).

(4) the *discovery learning model* of Bruner (1960, 1961, 1966, 1972) (strictly cognitivistic with little control). Concepts and principles should not be simply presented to the learner in a ready-made way; instead, learners should be encouraged by a problem-orientated approach to discover and formulate relevant concepts themselves.

(5) the *structural communication model* of Egan (1972, 1974, 1976) (pronouncedly cognitivistic with moderate control). Taking up the ideas of Bruner and Ausubel the model aims at deeper understanding. The technique tries to create conditions for the learner which provide an incentive to develop creativity, to formulate hypotheses, to make decisions and come to conclusions.

(6) the *model for facilitating learning* of Rogers (1967, 1969) (cognitivistic approach related to a personality theory; renunciation of control to the greatest possible extent: 'freedom to learn'). The learners should determine their own learning objectives. Any learning of value for the learner must be 'experiental learning' connected both with the actual situation and with the learner's experience. Learning always affects the entire person and not only the cognitive areas. Learning should be self-initiated; even if there is initiation from outside the wish to learn has to emerge from the learner himself. The teacher's task - Rogers prefers the term 'facilitator' - is to facilitate and to promote learning. As the learner himself should take the responsibility for his/her learning (e.g. in choosing the objectives or in evaluating the learning process) strict curricular guidelines are to be rejected.

(7) the *general teaching model* of Gagné (1972, 1975, 1976, 1977 etc.) (a model which tries to integrate ideas from various other teaching and learning theories; in recent versions the model is conceived in a cognitivistic way as an information processing model). The model provides a taxonomy of different domains of learning: verbal information, intellectual skills, cognitive strategies, attitudes, and motor skills. Gagné (1977, Ch. 11) recommends that the learning process be planned in three steps: (a) goal (or task) description; (b) learning analysis: determining the capabilities and the knowledge required for the learning task; and (c) deriving the external conditions favourable to learning. Among the latter are the so-called *instructional events* (for example activating motivation, informing learner of the objectives, directing attention, enhancing retention, promoting transfer of learning, eliciting performance and providing feedback), which are related to the learning phases assumed by Gagné.

The most important results of Bååth's analysis of the models with regard to their applicability in distance education are: (1) all models can be more or less easily applied to distance education; (2) the more the models provide control in the direction of strict, given objectives and the more they emphasize the importance of learning material (compared with the tutor-learner communication), the easier is it to realize them under conditions of distance education: models stressing structuring (like those developed by Skinner, Gagné, Ausubel or Egan) can be easily applied; less structuring or less controlling models or conceptions (like Bruner's and especially Rogers' model) can also be applied to

distance education; but in these cases particular measures have to be taken - for instance special forms of individualized tutorial support.

The impact of some of the models discussed by Bååth - like e.g. Skinner's model - has decreased during the last couple of decades. Nevertheless Bååth's analysis is very valuable, especially because he has shown that distance education can be designed according to several models, which are very different between them as far as the underlying conceptions of learning and teaching are concerned. In each model the learning material and the various forms of tutor-learner communication have different functions and/or are of a different importance.

There are no similarly thorough analyses of the applicability of more recent instruction theories to distance education comparing various models (e.g those discussed in the two volumes edited by Reigeluth 1983, 1987a or the instruction theories mentioned in Gagné & Dick 1983, pp. 264-275; furthermore cf. Glaser 1982, 1987). On the one hand this may be due to the fact that there are, according to Mitchel (1986), no similarly influential models in the 80s (as at least some of the models of the 60s and 70s described by Bååth were). On the other hand it may be due to the unsatisfactory character of the recent theories: Snow & Swanson (1992, p. 585) point out the fragmentary state of present instructional research, the results of which lead to various, partly incompatible, learning and teaching theories. Resnik (1984, pp. 431f) laments that up to now cognitive psychology mainly deals with a 'theory of expertise' or a 'cognitive task analysis', whereas other components which are important for an instructional theory - like a theory of acquisition of knowledge and a theory of intervention - are still to a great extent unexplored (cf. also Resnik 1989b).

As an example of a more recent theory which is practically tested in distance education (cf. Koeymen 1983), the elaboration model of Reigeluth (1979, 1987b; Reigeluth & Stein 1983) is briefly outlined here: Instruction begins with a survey of the main areas of the learning contents (from a wide-angle perspective, so to speak). Afterwards one part is, similar to a zoom, regarded in more detail to a certain degree and elaborated. After this, attention reverts to the survey level and the context of the part that has just been regarded in a more detailed way is made clear. This process is executed for each part (up to a certain level of detail). The same procedure (varying different levels of detail) can be carried out on an even deeper detail or elaboration level, and again it can be applied to each part of the subject matter. As it refers to a more or less global structure of instruction Reigeluth's elaboration model may be considered a macro theory. The model may be complemented by Merrill's component display model (1983, 1987) as a micro theory which puts the emphasis on the detailled structuring of instruction. Merrill's and Reigeluth's models are - like the Gagné model - applicable to various instruction contents and contexts.

Further, Hosford's approach (1975) should be mentioned, because he has not only presented a separate, very comprehensive instructional theory, but also because he has formulated criteria and minimum requirements for instructional

theories, relevant also for the development of instructional theories in the field of distance education (for an evaluation of this approach see Covill-Servo & Hein 1983 and elsewhere).

On the whole, attempts to design distance-study courses according to the principles of a particular teaching and learning theory are rare (examples are the application of Gagné's theory to the design of distance-education courses in Scandinavian distance-education institutions - i.a. by Ahlm 1972 or Lampikoski & Mantere 1976); the application of Ausubel's and Rothkopf's models to course material of the Universidad Nacional Abierta in Venezuela by Benkö de Rotaeche 1987; the application of the model of the 'guided didactic conversation' by Holmberg et al 1982 in distance-study courses for German and Swedish students; the use of Reigeluth's elaboration model in connection with Merrill's component display model in the course production of a Turkish distance-education institution - cf. Koeymen 1983). Reasons for the comparatively rare use of theories as guidelines are, among others: (a) The recommendations for the design of courses resulting from general (i.e. not subject-specific) instruction theories are often too vague, and frequently, they do not offer more than common sense or practical experience would suggest (cf. e.g. Macdonald-Ross 1979, p. 257). (b) Most distance-education institutions engage external authors; therefore it is difficult to find authors who are not only willing but also able to write course material according to the principles of a particular instruction theory.

5 Learning with media

As teachers and learners are geographically seperated from one another learning in distance education always also means learning with media (for teaching media and learning with media see, for example, Issing 1988, Weidenmann 1988 or Clark & Salomon 1986). The most important medium in distance education is still written material; in a large majority of distance-education institutions the printed course unit is the principal medium (cf. i.a. Doerfert & See-Bögehold 1988). In the following, learning with texts will be discussed in some detail, whereas other media are only mentioned briefly.

5.1 Learning based on texts

In written study material and in discussions about learning based on texts, distinctions are usually made between two components: (1) the presentation of the subject matter (*subject matter discourse*) or the instructional text as such and (2) learning aids or additional didactic elements (*instructional devices*, *adjunct aids* or similar terms) which aim at controlling and facilitating learning; in this category belong such elements as advance organizers, learning objectives, inserted questions, etc. (for the design and structuring of texts cf. the text collections edited by Jonassen in 1982 and 1985.)

At least early instructional research dealt more with the control of learning by means of such additional didactic elements than with the subject matter discourse in the narrower sense. In this way Rothkopf differentiated two classes of problems in his instruction model: first, how the learning material should be arranged to produce efficient learning; and second, what should be done to ensure the effective use of learning materials; according to Rothkopf this second problem can be more easily solved than the first one (for criticism of this see Macdonald-Ross 1979, pp. 247ff). As a consequence interest was directed to finding ways to use texts more effectively with the help of additional didactic elements and learning aids. In the course of more recent theories of cognitive psychology the attention has again been directed more to the texts themselves and their structure. In the framework of these theories, text comprehension is understood as the creation of mental representations or as the construction of meaning (cf., e.g., Resnik 1984; Schnotz 1988a,b; Weidenmann 1986).

In the following, first theories related to text comprehension will be briefly outlined, and then the learner friendly design of study material will be dealt with.

5.1.1 Theories of text comprehension

The following presentation is mainly based on Schnotz (1988a,b). He describes the development of the theories of text comprehension as a transition from additive-elementary via holistic to integrative approaches:

In *additive-elementary approaches* mental representations of texts consist of semantic units, so-called propositions, which are combined into a coherent whole (cf. de Beaugrande 1980; Crothers 1972, 1979; Frederiksen 1975, 1977; Graesser 1981; Kintsch 1974; Kintsch & van Dijk 1978; Meyer 1975). The propositional representation is created by transforming the text, phrase by phrase, into propositions. In doing so much of the linguistic structure of the text read is preserved. According to Schnotz (1988b, p. 304) such models only apply to the comprehension of rather simple texts.

The *holistic approaches* are based on the assumption that during the comprehension of texts a mental representation is created which has, right from the beginning, a holistic character; such mental represenations are referred to as *scenarios* Sanford & Garrod 1981), *situational models* (Collins, Brown & Larkin 1980) or *mental models* (Johnson-Laird 1983).

First, a scenario or model is activated during reading, to which the reader tries to apply the sentences following; in the course of the reading process the initial model, at first little specified, is then accordingly specified, differentiated and extended. Thus, text comprehension turns out to be a process of activating and elaborating models or scenarios. From the beginning the mental representation goes further than the contents presented explicitly in the text. When the processing of the text has not yet been finished, the model contains unspecified (variable)

slots which correspond to the open questions of the readers to the text. These slots are filled by information from the following text passage or inferences (for inferences cf. among others Rickheit & Strohner 1985). A mental model is constantly being evaluated by means of prior knowledge (cf. Collins, Brown & Larkin 1980) and tested with regard to the agreement with the text information, plausibility and completeness. If too many questions remain unsolved, a re-structuring of the model may be necessary.

The *integrative approaches* start from the assumption that text comprehension is accompanied by the development of basically different types of mental representation.

Thus van Dijk & Kintsch (1983; cf. also Kintsch 1989) presume that during the comprehension of texts three kinds of levels of mental representation can be distinguished: (1) mental *representation of the text surface*: this representation results from the semantic-syntactic processing of the text sentences. (2) propositional representation, the so-called *text basis* (cf. Kintsch 1974; Kintsch & van Dijk 1978); this representation is the result either of combining successive sentences or of creating coherence on the level of the text's semantic deep structure. (3) construction of a *situational model* or a *mental model* of the contents exposed in the text by integrating text information and prior knowledge. Correspondingly, text comprehension includes the formation of a mental representation of the text surface, the formation of a propositional representation on the basis of this mental representation, and finally, the construction of a mental model on the basis of this propositional representation.

Johnson-Laird (1983) also assumes that generally both a propositional representation and a mental model, differing fundamentally in their structures and functions, are constructed: Whereas the propositional representation is essentially based on the combination of internal symbols or discretional information units, the mental model is an holistic analogous representation of the subject matter to be described. The propositional representation requires rather little processing and is especially appropiate for recognition of text information, but less for long-term retention. Contrary to this, a mental model demands more processing and is retained in the memory much longer; as it is closer to the structure of the exposed subject matter, it is particularly suitable for drawing inferences. Mental models facilitate the answering of questions concerning text comprehension, and they are helpful in the application of what has been learned: Thus, the creation of a propositional representation corresponds to rather superficial understanding, whereas the creation of a mental model leads to deeper understanding. (For results which make it seem plausible to distinguish different levels of representation during text comprehension see Schnotz 1988b, pp. 317ff).

Due to the limited processing capacity the reader has at hand, at any particular moment, neither the entire text so far read, nor the whole text basis, nor the entire mental model so far created, but only parts of the whole model of the subject or topic in question. (The topic contains information about the learning matter which

each text segment has actually dealt with; the topic denomination in each text segment functions as a label for the actual partial model and helps the reader to find and activate the relevant prior knowledge.) As long as the treatment of a subject continues, the corresponding partial mental model is carried forward from sentence to sentence and is thus successively enriched.

While reading a thematically discontinuous text with many topic changes the reader has to interrupt the construction of the present partial model at each change of topic and to go over to working at another partial model. Readers of a discontinuous text structure first concentrate on building up a propositional representation and develop a strategy of retention. Contrary to this, readers of a continuously structured text use only so much time and energy for the building of a propositional representation as is necessary for the creation of a mental model and tend to follow a strategy of comprehension.

In the framework of the so-called procedural semantics (cf. Longuet-Higgins 1972; Woods 1981) the topic information being included in a text segment may also be interpreted as a trigger for a search procedure and as an aid in focus tracking (Sidner 1983). The topic denomination has to be designed in such a way that the reader succeeds in focus tracking. Furthermore, in the framework of focus tracking, the degree of the marking or accentuating of a topic, which can be influenced by particular syntactic structures (Givón 1979, 1983), has a signalling function for the reader. The more the topic is accentuated or marked, the more probable is it that the reader expects a change of the topic.

Schnotz (1988a) illuminates some implications and questions arising from recent approaches with regard to the design of teaching material and emphasizes their heuristic function (Schnotz 1988a, p. 17): They provide new perspectives on old instructional problems so that one is able to ask new and more precise questions.

However, up to now there is no instructional theory that makes it possible to coordinate the implications of the above mentioned theoretical approaches into instruction rules manageable for practical use; it is also undeniable that some of the implications outlined by Schnotz - e.g. concerning the emphasis of a topic change - contain nothing but what an experienced text writer does anyway.

5.1.2 A learner-friendly text design

A 'learner-friendly design' (cf. Weidenmann 1986) of course units may apply to a) the presentation of the teaching matter in a narrow sense and b) additional didactic elements (on which see below 'Learning aids').

In presenting the teaching matter one can either be guided - apart from aspects of subject matter methodology - by one of the instructional theories (e.g. Reigeluth's elaboration theory or Holmberg's model of guided didactic

conversation), or by aspects of recent text comprehension research (see above). There are also other aids applicable to the design of texts: readability formulas and concepts for the assessment of the text comprehensibility and general evaluation procedures.

5.1.2.1 Readability and text comprehensibility

The aim of readability formulas is to predict the degree to which a text is read and understood. Readability formulas use one or more text features (like word frequency or sentence length) that allow statistical prediction of the text difficulty. The formulas are applied directly to the text, and there is no need for evaluation by testers; they are thus simple and easily manageable. (A further method to define readability - the so-called cloze-procedure - is based on learner testing). Surveys of readability formulas and measurement procedures are to be found in Klare (1974/75; 1976a,b). The formulas developed by Dale & Chall (1948) and Flesch (1948) are those most frequently applied - an updated version of both formulas is to be found in Powers, Sumner & Kearl (1958).

There are clear signs of readability in the sense of readability formulas and effectiveness being related to each other. Klare & Smart (1973) found a rank correlation of .87 between the level of readability of correspondence study material and the percentage of learners who sent back all assignments for submission. In his survey of text research Macdonald-Ross (1979) comes to a positive judgment on the usefulness of readability measurements. He advocates the use of readability formulas as a kind of rough sieve or control instrument when producing study material. This may be done in a cyclic way (writing ==> application of formulas ==> revision of the text ==> application of formulas etc.). Schnotz (1988a), on the other hand, is very critical. Among other things, he criticizes early readability research for not paying attention to the mental processes during text comprehension and for concentrating on external text features only.

Criticism of early readability formulas and their concentration on formal surface features caused Groeben (1972) and Langer, Schulz von Thun & Tausch (1974) to search for alternative criteria, those of the so-called "text comprehensibility". Groeben referred to general concepts of cognition and motivation (from Ausubel, Berlyne and information theory). Langer et al started out from expert ratings. The results of both approaches are factors of comprehensibility such as 1) simplicity of sentence structure and vocabulary, 2) structure and cohesion, 3) succintness, and 4) additional stimulation (see also Weingartz 1981, Chapter 2, and Weidenmann 1986, pp. 520f). According to Schnotz, (1988a, p. 6) what goes on psychologically in the minds of the learners while reading remains vague or implicit in both cases; the resulting recommendations are hardly more than everyday knowledge.

5.1.2.2 Evaluation

Almost all major distance-education institutions evaluate their teaching materials. The prevailing type of evaluation is formative in the sense of a developmental testing (concerning the evaluation in distance education see Schuemer 1991 or Thorpe 1988). Common procedures are the testing of course material with students as testers and procedures of text criticism. However, the value of evaluation is not undisputed. Thus, Macdonald-Ross (1979) objects not only that the procedures are very time consuming and expensive; furthermore, he doubts their effectiveness: seldom does formative evaluation yield other or more precise insights than those which an experienced analyst would reach less expensively and more quickly. Therefore, he claims most course developers use the evaluation results merely rhetorically to support the suggestions they would have made anyway (p. 232). A more positive appreciation of text evaluation procedures occurs in Wright (1985); cf. further Komoski & Woodward (1985) who discuss procedures for the revision of instructional texts to describe and improve their learning effectiveness ('learner verification and revision', LVR).

5.1.2.3 Learning aids

Before didactic elements such as explicit objectives, questions or similar things are looked into, the term 'access structure' should be briefly discussed. Instruction theorists and course planners (mostly implicitly) assume that reading is a process that always proceeds from the beginning to the end. Waller (1977a,b) criticizes this model and coined the term 'access structure' (see also Macdonald-Ross 1979). As particularly distance students generally suffer from lack of time (see above) they for this very reason have to develop selective reading strategies. According to Waller a reader is not only active in the sense that he struggles with the correct comprehension of the text but also in selecting what he reads. Under this aspect the didactic elements in texts (like inserted questions, learning objectives, etc.) must also be seen above all as aids for planning and executing reading strategies; thus, e.g., learning objectives, summaries or questions may be used by the learner - contrary to what the course developers have planned - only as instruments supporting selective reading. The question where educational aids should be placed in the text also loses much of its importance when learners do not adhere to the planned reading order.

Advance organizers

This concept goes back to Ausubel (Ausubel 1960, 1963; Ausubel & Fitzgerald 1961, 1962; Ausubel & Robinson 1969; and elsewhere). Ausubel is concerned with meaningful verbal learning (in contrast to mechanical memorizing) and assumes that learning of new material is performed in terms which are already known to the reader. Meaningful knowledge emerges from a process through which new material is merged with the cognitive structure of a learner. The new material is subsumed under more general ideas and concepts in the already existing structure.

Advance organizers are a means to connect the new material with the learner's prior knowledge and cognitive structure. They should be of a more general and abstract character than the learning matter that follows; thus they differ from introductory surveys or summaries.

In order to explain the effect of the organizers Ausubel refers to the principle of progressive differentiation and to the principle of integrative reconciliation. *Progressive differentiation* means that the most general and comprehensive ideas belong to the beginning of the teaching/learning process and that what follows should be more and more structured and detailled (progression from the general to the particular and from the abstract to the concrete). *Integrative reconciliation* (contrary to compartmentalization) entails that the different parts and concepts of teaching material are not presented in isolation but in relation to each other (cf. Ausubel, Novak & Hanesian 1980, pp. 230ff).

There are numerous studies of the effectiveness of advance organizers with show varying and contradictory results (cf. Jonassen 1982b, who also gives some advice on how to write organizers): In a survey of preceding studies Barnes & Clawson (1975) conclude that advance organizers are not efficient; however, Mayer (1979) criticizes Barnes & Clawson's analysis (cf. also Lawton & Wanska's criticism 1977) and concludes that under certain conditions advance organizers promote learning. Luiten et al (1980) also come to a positive conclusion in a meta-analysis on the basis of 135 single studies. Marland & Store (1982) also evaluate the organizers in a rather positive way, and provide some advice for their application to distance-education material. Macdonald-Ross (1979, pp. 251ff) sees the sometimes contradictory results, at least partly, as consequences of insufficient operationalization of the 'organizer' concept (cf. also Hartley & Davies 1976). According to Marland & Store (1982, pp. 78ff), the insufficient operationalization is also one of the reasons why advance organizers are so little used in distance-education texts.

Learning objectives

The definition of teaching and learning objectives is supposed to serve several purposes: It is supposed to facilitate the planning and development of teaching materials and serve communication among the developers about the contents that are to be taught. Learning objectives are meant to inform the learners about what they must have learned at the end of a course and what requirements they will have to meet (e.g. in later examinations); moreover, objectives may function as orientation guidelines and help students to organise their learning activities. Furthermore, objectives should also be useful both for the formative and summative evaluation of the teaching materials and for the evaluation of learner performance (e.g. when corresponding criteria-orientated performance tests are constructed). Reference to learning objectives can be found in the reviews of Holmberg (1989, pp. 35-41), Macdonald-Ross (1973, 1979), Marland & Store (1982) and Popham (1987).

According to Popham (1987) the occupation with objectives in the field of education has been fundamentally influenced by two approaches: (1) the objective-attainment model of evaluation developed by Tyler (1949) according to which educational programmes have to be evaluated on the basis of how far they have contributed to the attainment of pre-determined (as fas as possible measurable) objectives; (2) Mager's insistence on *behavioural* objectives (1962). The intensive occupation with learning objectives has gradually given way to a more down-to-earth evaluation: In his review Popham states that in the earlier years the importance of objectives was over-emphasized and Marland & Store (1982, p. 84) even speak of a general obsession with objectives in educational planning.

There have been intense controversies about objectives and their wording; sometimes objections based on principle have been put forward against learning objectives and sometimes the wording of learning objectives in behavioural terms has been opposed: The supporters of the wording of learning objectives in behavioural terms (e.g. Popham 1964) argue chiefly that the objectives are made very clear when expressed in behavioural terms. The opponents (Arnstine 1964, Eisner 1967 and others) argue, among other things, that the most important educational objectives cannot be expressed in behavioural terms; they claim that the predominant occupation with behavioural objectives leads to a kind of educational reductionism as the trivial is often specified as an objective - only because it can be easily measured.

Very far-reaching objections are put forward by Macdonald-Ross (1973, furthermore 1979, pp. 250-251), only a few of which are to be mentioned here: (1) The objective-attainment model in the field of education is doubtful in many respects. (2) The definitions of objectives - also those in behavioural terms - are ambiguous. Therefore, objectives contribute only in a limited way to the communication between the course developers; further, objectives also only to a limited extent serve communication with learners as they are often expressed in terms which are not to be learned until later in the learning process. (3) Objectives do not solve the problem of an optimal instructional sequence, as there are a great number of possible ways through each area of knowledge; therefore, their efficiency in planning is reduced. (4) Learning objective definitions in behavioural terms cannot be applied to all subjects and all levels of education. (5) The problem of the specificity of objectives has never been solved.

Popham (1987), who still supports the use of objectives in behavioural terms, also refers to the problem of hyper-specificity: behavioural terms encourage the tendency to formulate increasingly detailled and specific behaviour segments as terminal behaviour; this leads to very long lists of objectives which - often merely because of their length - will hardly be taken into account. Instead, Popham advocates summarizing a number of very specific objectives under more general but still measurable objectives. Furthermore, Popham holds a critical view of taxonomies of educational objectives like Bloom's et al (1956; for the cognitive area) or Krathwohl's et al (1964; for the affective area). Popham regards the detailled analysis of objectives and their classification into objectives of lower and

higher rank (in the sense of taxonomies) as difficult and little productive. Instead, he recommends the use of taxonomies only for heuristic purposes - e.g. in order to find out if a programme or a course contains affective learning objectives, for instance, or if its learning objectives deal predominantly with rote-recall knowledge. Popham (1987) also makes some recommendations on how to express and apply objectives. (Advice focusing especially on learning objectives in distance-education courses can be found in Marland & Store 1982, pp. 88ff).

With regard to the effectiveness of objectives for learning, several surveys have been carried out, the results of which are, however, on the whole contradictory (cf. Faw & Waller 1976, Hartley & Davies 1976, Marland & Store 1982, Melton 1978). Macdonald-Ross (1979, p. 251) criticizes that most empirical studies of objectives disregard the most important conceptual problems and therefore rather cause confusion than provide clarity. According to Marland & Store (1982, p. 87) the tendency can be noticed that, whereas learning objectives support intentional relevant learning, they rather diminish incidental learning (perhaps as a result of selective attention - cf. Duchastel 1979, Faw & Waller 1976). For further tendencies see the table illuminating some results in Marland & Store (1982, p. 86).

Concerning the optimal *positioning* of objectives within a teaching package no simple prescriptions can be given. Usually the objectives are placed at the beginning, and in this position they either serve as attention guides or specify the level of knowledge desired after the end of the learning process (in the sense of a *goal statement*). However, if the learning objectives are used by the learner mainly as orientation aids (in the sense of Waller's *access structure*), the positioning is rather a practical question. There are some arguments in favour of placing the objectives at the end - and to state the number of the page, on which the corresponding subject matter is dealt with (cf. Macdonald-Ross 1979); thus, the objectives may also be used by the learner as a kind of check list - for example when preparing for tests. If there are many specific learning objectives, Marland & Store (1982) suggest not to place them en bloc at the beginning or the end but to assign each objective to the corresponding segment in the text.

Several times it has been proposed to use objectives expressed in a suitable way as advance organizers (cf. e.g. Holmberg 1989, p. 39). Contrary to this, Macdonald-Ross (1973) doubts that objectives are suitable as advance organizers - among other things because, at the beginning of the learning process, the concepts required for objectives on the abstract and general level advocated by Ausubel are not sufficiently known by the learners.

In spite of the objections put forward by Macdonald-Ross and others, which have to be taken very seriously, pragmatic reasons in particular speak in favour of maintaining statements of objectives in distance-education courses: the very effort to express objectives in the most clear and communicable way is helpful for the planning and development of distance-education material; in many fields of learning the wording of objectives in behavioural terms contributes to better

communicability, even if ambiguities and misunderstandings can hardly be entirely avoided.

The real problems related to the definition of study objectives less concern their effectiveness as guiding instruments than their appropriateness seen from the point of view both of the individual and of society (cf. Holmberg 1989, pp. 40-41). Therefore, the crucial question is who decides what the objectives are and how they are to be expressed; in order to encourage learner autonomy it is of vital importance to what extent learners can decide for themselves not only *how* but also *what* they want to learn (or at least, how he or she can participate in the decision). (In that way, Potvin 1976 refuses institutions the right to impose on the learner what they must learn; on the other hand, Candy 1991, p. 100, holds a sceptical view of approaches allowing learners to control the selection of the learning objectives). Thus, to guarantee individualized learning, it proves important to organize distance-education courses in such a way that each learner can choose between a number of smaller units with clearly defined objectives. In doing so the learner is able to compile for himself/herself the combination of units which corresponds best to his or her individual goals. Approaches of this kind aiming at facilitating learners' choice of study objectives have been developed by Potvin (1976) and Ljoså & Sandvold (1983). (Contract learning, mentioned above, offers even more far-reaching possibilities for learners themselves to decide on their learning objectives.)

Questions in the text

Questions in teaching texts (*'in-text questions, 'adjunct questions', 'inserted questions'*) are a frequently used didactic means with varying functions (to stimulate the learner to be more active and to deal more intensively with the learning matter, to guide attention, to prepare learners for the kind of questions used in later tests etc.).

In their review of relevant analyses Rickards & Denner (1978) distinguish between studies having a "variable orientation" and studies with a "process orientation" in question research. Earlier studies are mostly behaviouristic and variable-orientated (e.g. the analysis of the effect on retention of the position of questions in text); more recent analyses are mostly cognitive and process-orientated (i.e. registration of the cognitive processes which are triggered off by questions).

The analyses following Rothkopf's 'adjunct questions' paradigm belong to the former studies. In these surveys mostly fairly short and little complex texts were used; the questions were either placed at the beginning or at the end of the text to be read, and in most cases they only aimed at the retention of facts in the memory. The object of the analysis dealt with was the extent to which the reader remembered the material he/she had been asked about (direct effect; intentional learning) and, on the other hand, that not referred to in question (indirect or mathemagenic effect; incidental learning). Contrary to 'natural' learning situations,

the test subjects (*Ss*) were not allowed to review passages of the text: therefore, Macdonald-Ross (1979; cf. also Marland & Store 1982) criticizes the small ecological validity of these analyses and the lack of transferability to natural reading situations. In general, only very small indirect or mathemagenic effects resulted from such studies. The indirect effects were cleary smaller than the direct effects, and they were so small that they are, according to Macdonald-Ross, hardly relevant for the course development.

In the later, process-orientated studies (since the 70s) the interest has been more and more focused on the cognitive processes brought about by questions. Research efforts are directed towards finding out how the wording of questions can influence the character and depth of the learning process. Watts & Anderson, e.g., (1971) showed that questions aiming at the application of rules induced a deeper and more far-reaching processing of the material. In a similar way Marton & Saljö (1976a,b) report that test students who after two paragraphs of a rather short text were asked questions testing their retention of superficial details in the further course of the learning process learn in a way different from that of *Ss* who were asked questions aiming at understanding. Thus the kind of questioning influences the kind and depth of processing.

From analyses of this kind Rickards & Denner (1978), Macdonald-Ross (1979) and Marland & Store (1982) draw the conclusion that questions aiming at learning processes of a higher order contribute to better recall and understanding of what has been read (on partly contradictory results cf. Lindner & Rickards 1985, however). What has not yet been made sufficiently clear, is the optimal placing of such questions in the text. Apart from this, the effects of the question conditions do not seem to be independent of the learner's characteristics ('attribute-treatment interaction': ATI-effect): questions of a higher order have a stronger effect on little competent readers than on competent ones (cf. Shavelson et al 1974a,b and others).

According to Marland & Store (1982) there is, up to now, only little research on the effect of questions in distance-education material. In their recommendations they advocate the use of questions aiming at understanding instead of the mere reproduction and memorizing of facts. Furthermore, Marland & Store suggest that learners should be encouraged to formulate questions on their own and to answer them (if possible in writting). (Such encouragement to ask questions could be combined with an instruction on how to apply a question scheme to stimulate elaborative processes - like Dieckhoff's et al 1982.)

At least some of the above considerations about questions in texts may also be valid for submission assignments in distance-education courses: in such assignments the way a task is set may influence the kind and extent of elaboration. There are, however, no corresponding empirical analyses.

Short reference to further didactic elements

Further elements in texts are not dealt with in this text. Information about illustrations and graphics in texts can be found in a review by Macdonald-Ross (1978); cf. also Weidenmann (1986, pp. 523ff), who pays special attention to the relationship between picture and text (complement / competition) and to the question of effectiveness. Illustrations (graphs) in distance-education courses are also looked into in Marland & Store (1982). They further discuss learning aids such as summaries and overviews in texts.

5.2 References to other media in distance education

Many distance-education institutions use other media to supplement the written material.

The *telephone* is used by various institutions for tutorial purposes (cf. Flinck 1978). Many institutions use audiocassettes, partly for subject matter presentation (e.g. in language courses) and partly for learner support (e.g. to comment on assignment tasks or to motivate the learner). *Video cassettes* may also be used as supplementing media. Moreover, video technology may be employed for the training of tutors (this is done at the Israel Open University; cf. Ganor 1992). Videos are especially suitable for contents for which a visualization (e.g. illustration of movement) or supplantation is helpful. (On supplantation see Salomon 1970, 1979; cf. furthermore Weidenmann 1986, p. 502 or Issing 1988, pp. 538ff. Supplantation is understood by Salomon as the external simulation of internal processes or a process in which a lacking internal process is reconstructed externally by a medium. If, for example, a learner has difficulties in extracting an essential part from a complex surrounding, a supplantation in the form of 'zooming' may help the learner; in a similar way also slow-motion and time-lapse effects may be used to illustrate movements or processes.)

Some major distance-education institutions cooperate with radio or TV companies - thus the British Open University with the BBC (daily programmes based on different course programmes) and the German FernUniversität with the WDR (a programme of half an hour every two weeks). The National Technological University in the USA has its own telecommunication network at its disposal. This transmits - in cooperation with various universities - TV-instruction programmes via satellite; additionally, computer and TV conferences are used.

Wupper (1992) conceived the idea of an "electronic study centre" on the basis of broadband communication or *videoconferencing*. According to his proposals seminars could be held in this way; especially such teaching contents as can only with great difficulty be mediated by written study material could thus be presented more clearly (e.g. demonstrations using instruments in technical subjects).
Video conference systems are - similar to computer-conference systems - basically suitable for 'reciprocal teaching' approaches also in distance education (on

'reciprocal teaching' see Palincsar & Brown 1984, Brown & Palincsar 1989; cf. Snow & Swanson 1992, p. 613).

In distance education the computer can serve various functions - apart from those related to administration and distribution: thus the correction and commenting of assignments for submission, teaching and learning as well as communication between learners and tutors or among the learners.

At the moment, *computer-based learning* still plays a rather subordinate role in distance education (cf. Ballstaedt et al 1992, pp. 7-10; on computer-based learning see e.g. also Mandl & Fischer 1985).

A good survey of the kinds of computer-based teaching/learning systems available at present is given by Mandl, Hron & Tergan (1990). Their account refers to 'open learning' (a teaching/learning form offering free access and especially taking into account the learning situation of the mostly adult learners); the developments and tendencies described by these authors are also relevant for distance education (especially because 'open learning' is often realized within the framework of distance education; cf. e.g. Thorpe & Grugeon 1987). For the application of the computer in distance education see also Bates (1990, Sections 6+7), Kaufman (1986), Mason & Kaye (1989) or O'Shea (1984).

Mandl et al (1990) suggest a model for describing and evaluating computer-based learning systems and divide the systems they describe into (1) tutorials and 'drill and practice' programmes; (2) simulation and model-building systems; (3) interactive video systems; (4) intelligent tutorial systems (ITS; see e.g. also Lesgold 1988, Mandl & Hron 1986, Mandl & Lesgold 1988 or Spada & Opwis 1985); and (5) expert systems. (Mandl et al also deal with computer-based diagnostic systems.)

Whereas the fairly simple systems - e.g. those of type (1) - are mostly very little flexible and are characterised by only a little extent of individualization, especially the intelligent tutorial systems aim at flexibility and individualization. Such systems try to adapt the computer-based instruction to the prior knowledge and to the learning progress of the individual learner. (In comparison with a human tutor, however, the adaptability of these systems are increasingly questioned; cf. Snow & Swanson 1992, p. 606, referring to Wenger 1987, p. 426.) According to Snow & Swanson (1992, pp. 604f)) the ITS differ with regard to the degree they control learners: some tend to take command and direct the learning, whereas others offer facilities for the learner's discoveries ('discovery environments'). However, in order to profit from a discovery environment, special prior knowledge and/or capabilities are necessary (cf. Pea & Sheingold 1987 and Steinberg 1989).

Snow and Swanson (p. 607) speak of a growing concern with regard to the question if the investments in the ITS-development have been worthwhile (cf. Lippert 1989). As an alternative to ITS expert systems which can be developed more easily could be used for instruction purposes: It is true that expert systems, modelling the way of thinking and the decision-making behaviour of experts, are

not in the first place conceived for learning. Nevertheless they can also serve learning purposes - if they are combined with guidance given by a human tutor (or under distance-education conditions if they are combined with a printed study guide).

In distance education, computer-based learning systems are mostly used in narrow and well defined areas of knowledge or skills as a supplement of written study material. At present relatively simple systems requiring only little expenditure of time and labour are predominant (e.g. of the type tutorial or 'drill and practice'). However, occasionally also more complicated systems are being tested or used (like Intelligent Tutorial Systems or Interactive Video Systems; examples of the latter are 'The Water Videodisc' of the British Open University or the 'Knowledge Acquisition Video Instruction Systems', KAVIS, developed at the German Institute for Distance Education; cf. Mandl et al 1990, p. 80). The German FernUniversität also is committed to the development of advanced computer-based training systems (see, for instance, the booklet "Applications of new learning and communication technology at the FernUniversität" edited by a study group in 1993).

However, the computer cannot only be used for teaching/learning purposes in the narrower sense, but also for communication purposes and for student support: *computer-conference systems* are of increasing importance for distance education (cf. Bates 1990, Section 7; Mason & Kaye 1989, Part 2; Lauzon & Moore 1989). Among other things, they can be used for tutoring and facilitate rapid communication between tutors and learners and especially among learners. A tutor can, for instance, answer recurring problems of learners by only one message to all of them. The learners are able to exchange information among themselves and to help one another. Especially the latter aspect is important as in this way a possible isolation of the distance students can be counteracted. Students can contact their fellow students without having to go to a study centre. Lauzon (1982) regards conference systems as a means to include the social or transactional character of learning in distance education. (In a similar way Lorentsen 1991 and Lorentsen & Rasmussen 1989 consider 'conferencing' a means for the realization of a communicative distance-education concept - instead of a distance-education approach that merely concentrates on the distribution of knowledge.) Corresponding computer-conference systems have been installed at many major distance-education institutions or are being tested - e.g. at the German FernUniversität (cf. Sternberger 1992), at NKI in Norway (cf. Paulsen & Rekkedal 1990) and at the Danish Jutland Open University (cf. Lorentsen & Rasmussen 1989). On an interesting attempt to combine computer-based learning with computer conferencing in distance education see Lauzon (1992).

Saba (1988) contains considerations on the use of integrated telecommunication systems in distance education - such as integrating picture/video and language or facilitating multitasking and shared communications - and the ensuing possibility to optimize "dialogue and structure" (Moore 1983).

A further important function of the computer in distance education is to correct and comment on the assignments for submission. Many of the larger distance-education institutions have developed appropriate correction systems. The learners submit their solutions in form of OMR-answer sheets which are fed into the computer and transformed into a corresponding answer letter - with individual explanations of mistakes, comments and assessment of the individual student's achievement (e.g. the LOTSE-system for many lower-level courses of the FernUniversität).

The possibilities of telecommunication (e.g. *electronic mail*, *teletext*, *telefax*) to decrease the turn-around time of submission assignments or questions by learners are important as long turn-around times entail demotivation and an increase of the drop-out rate (cf. Rekkedal 1983). (On telecommunication media in distance education see e.g. also Wurster 1992.)

Acknowledgments

This paper is a revised version of Part II in Holmberg, B. & Schuemer, R. "Lernen im Fernstudium" (prepared for Mandl, H. & Weinert, F.E., eds.: Psychologie der Erwachsenenbildung, vol. 4 in the series "Pädagogische Psychologie" of the "Enzyklopädie der Psychologie", Göttingen: Verlag für Psychologie, Hogrefe; in press).

I would like to thank Börje Holmberg for many helpful suggestions. His influence on this paper is gratefully acknowledged. I am also grateful to my colleagues Helmut Fritsch, Helmut Lehner and Gerhard Ströhlein for reviewing earlier versions of this paper.

Translations from the original paper have been done by Jutta Licht, Claudia Steinbach and the author (with the permission of the editors of "Psychologie der Erwachsenenbildung").

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